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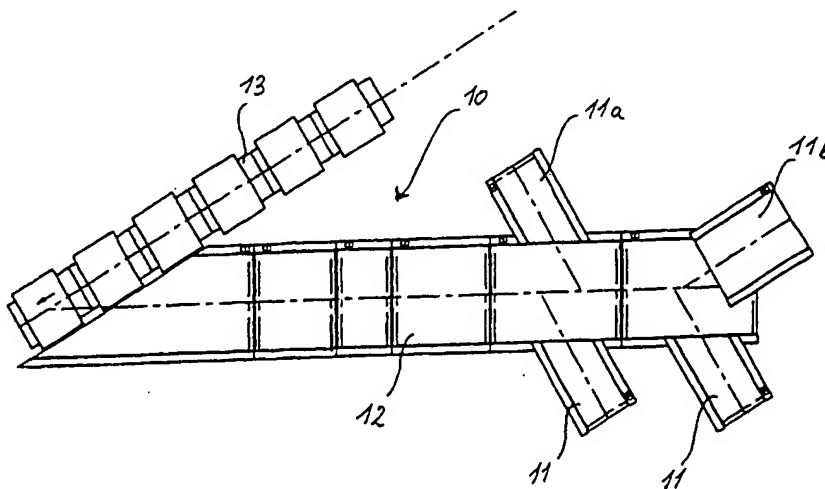
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(54) Title: A CONVEYOR SYSTEM



(57) Abstract

A conveyor system (10) and a method of feeding at least two flows of articles onto a main conveyor (13) of the conveyor system. The at least two flows of articles are conveyed along an individual supplying conveyor (11, 11a, 11b), and the method comprises the steps of transferring each flow of articles being conveyed along the supplying conveyors (11, 11a, 11b) onto a feeding conveyor (12), and thereby merging the two flows of articles into one flow of articles on the feeding conveyor (12). Thereafter, the flow of articles on the feeding conveyor (12) is fed onto the main conveyor (13). The conveying direction of the two supplying conveyors (11) is substantially perpendicular to the conveying direction of the main conveyor (13) at the point where the flow of articles on the feeding conveyor (12) is transferred onto the main conveyor (13). The supplying (11, 11a, 11b) or feeding conveyor (12) may comprise a belt conveyor, and the main conveyor (13) may comprise a cross-belt or tilt-tray conveyor. The main conveyor (13) may be adapted to sort the articles.

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A CONVEYOR SYSTEM

The present invention relates to a conveyor system and a method of feeding at least two flows of articles onto the main conveyor of the conveyor system. The invention further
5 relates to a control system for controlling the flow of articles in the conveyor system and to a method of operating the conveyor system.

An object of the present invention is to provide a conveyor system providing a control system which is capable of controlling the flow of articles in the conveyor system. In
10 particular, it is an object of the invention to provide a conveyor system which is less area consuming than known conveyor system. It is further an object to provide a conveyor system where the space available on the main conveyor is used in an economical way.

In a first aspect, the present invention provides a method of feeding at least two flows of
15 articles onto a main conveyor, each of the at least two flows of articles being conveyed along a supplying conveyor, the method comprising the steps of:

- transferring each of the flows of articles being conveyed along the supplying
conveyors onto a feeding conveyor, thereby merging the at least two flows of articles
20 into one flow of articles on the feeding conveyor;

- transferring the flow of articles on the feeding conveyor onto the main conveyor,

the conveying direction of at least one of the at least two supplying conveyors being
25 substantially perpendicular to the conveying direction of the main conveyor at the point where the flow of articles on the feeding conveyor is transferred onto the main conveyor.

The main conveyor, the at least two supplying conveyors, and the feeding conveyor preferably constitutes a part of a conveyor system. The articles being conveyed by this
30 conveyor system are preferably introduced into the conveyor system at the supplying conveyors, most preferably at one end of the supplying conveyors. Some articles may thus be introduced at one supplying conveyor while other articles are introduced at another supplying conveyor.

The conveying direction of all the supplying conveyors may be substantially perpendicular to the conveying direction of the main conveyor at the point where the flow of articles on the feeding conveyor is transferred onto the main conveyor. However, at least one of the supplying conveyors may be positioned at the end of the feeding conveyor, so that the
5 conveying direction of such a supplying conveyor is substantially the same as the conveying direction of the feeding conveyor. Alternatively, the conveying direction of the at least one supplying conveyor may be substantially parallel to the conveying direction of the main conveyor at the point where the flow of articles in the feeding conveyor is transferred into the main conveyor.

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The conveying direction of the feeding conveyor defines an angle with the conveying direction of the main conveyor at the point where the flow of articles on the feeding conveyor is transferred onto the main conveyor. This angle is preferably between 0° and 90° , such as between 10° and 75° , such as between 20° and 60° .

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The feeding conveyor preferably establishes a conveyor connection between each of the supplying conveyors and the main conveyor. Most preferably, it establishes a conveyor connection between the end of the supplying conveyors being opposite to the end where articles are introduced, and the main conveyor.

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Thus, an article is preferably introduced at one end of a supplying conveyor. The article is then conveyed by the supplying conveyor to the opposite end of the supplying conveyor where it is transferred to the feeding conveyor. It is then conveyed by the feeding conveyor to the main conveyor, onto which it is transferred.

25

The main conveyor is preferably a closed loop conveyor, most preferably a sorter. It may be provided with carts or wagons, each carrying, e.g., a tiltable tray or a cross belt. It may, however, also comprise one or more belt conveyors and/or one or more roller paths and/or any other suitable kind of conveyors.

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The supplying conveyors and the feeding conveyor are preferably belt conveyors, but they could also be any other suitable kind of conveyors, such as roller paths or chutes.

When elongated articles are loaded onto a conveyor they will normally be oriented in such a way that they protrude in the conveying direction of the conveyor onto which they are loaded.

- 5 In known conveyor systems articles are normally fed to the main conveyor by some kind of feeding conveyor, the conveying direction of the feeding conveyor defining an angle with the conveying direction of the main conveyor, the angle being less than 90° in order to ensure that the velocity of the articles being transferred from the feeding conveyor to the main conveyor has a component in the conveying direction of the main conveyor.

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Thus, when the articles have been transferred to the main conveyor they will normally be oriented in such a way that they protrude in a direction which has a component in the conveying direction whereby the space available on the main conveyor is not used in an optimal way.

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By providing one or more supplying conveyors to the feeding conveyor in such a way that the conveying direction of the one or more supplying conveyors is perpendicular to the conveying direction of the main conveyor it may be ensured that the articles which have been transferred to the main conveyor will protrude in a direction which is perpendicular to
20 the conveying direction of the main conveyor, provided that they have been loaded onto the supplying conveyor in such a way that they protrude in the conveying direction of the supplying conveyor(s). Thus, the space available on the main conveyor is used in an optimal way.

- 25 A further advantage of the invention is obtained by providing each feeding conveyor with at least two supplying conveyors, thereby increasing the loading capacity of each feeding conveyor. Thus, the amount of feeding conveyors required in order to provide the wanted capacity to the conveyor system is decreased, thereby reducing the area requirements for operating the conveyor system.

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Thus, a conveyor system is provided which is less area consuming than known conveyor systems and in which the space available on the main conveyor is used in an optimal way, whereby the capacity of the conveyor system is increased. It will thus be less costly to install as well as to operate a conveyor system according to the invention.

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The method may further comprise the steps of:

- selecting one of the at least two supplying conveyors according to at least one criterion selected from a first set of criteria;

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- transferring an article from the selected one of the at least two supplying conveyors onto the feeding conveyor.

Thus, it is possible to select a supplying conveyor carrying an article which need to be
10 transferred onto the feeding conveyor and further onto the main conveyor.

The method may further comprise the step of transferring an article from the feeding conveyor onto the main conveyor at a given time and according to at least one criterion selected from a second set of criteria.

15

The transferring of the article onto the feeding conveyor and/or onto the main conveyor is preferably performed by activating the supplying conveyor and/or the feeding conveyor. It may, however, alternatively be performed by pushing or pulling the article onto the feeding conveyor/main conveyor by means of, e.g., actuators which may be driven by, e.g.,
20 pneumatics or hydraulics or by any other suitable means.

The method may comprise the step of assigning a priority level to substantially every article being conveyed along any of the supplying conveyors.

25 Preferably, the priority level is assigned to the articles as soon as they enter the supplying conveyor. The priority level may, however, alternatively or additionally be assigned before the article enters the conveyor system or it may be assigned later, e.g., while the article is being conveyed along the supplying conveyor or the feeding conveyor or the main conveyor.

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The information about the priority level of a certain article may be comprised in, e.g., a bar code or a transponder which is attached to the article. It may alternatively or additionally be stored in storing means comprised in a control system whereto it may be entered manually or by a bar code scanner or by any other suitable means.

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The first set of criteria mentioned above may consist of:

- (a) sufficient space for an article to be transferred from the supplying conveyor to the feeding conveyor is available on the feeding conveyor;
- 5 (b) an article on the supplying conveyor is present in the vicinity of the feeding conveyor;
- (c) at least one of the articles being conveyed along the supplying conveyor has the highest priority level of all articles which may be transferred from any supplying conveyor to
10 the feeding conveyor within a certain time interval;
- (d) at least one of the articles being conveyed along the supplying conveyor has been on the supplying conveyor for a longer time interval than a predetermined time interval.

15 Thus, a supplying conveyor may be selected if sufficient space is available on the feeding conveyor so that the article positioned closest to the feeding conveyor on the supplying conveyor may be transferred to the feeding conveyor, or a supplying conveyor may be selected if sufficient space is available on the feeding conveyor that two or more articles positioned on the supplying conveyor may be transferred to the feeding conveyor. Or even
20 if sufficient space is available on the feeding conveyor that all the articles positioned on the supplying conveyor may be transferred to the feeding conveyor.

Alternatively or additionally, a supplying conveyor may be selected if an article on the supplying conveyor is present in the vicinity of the feeding conveyor. The article may be
25 tracked from a position which is distant from the feeding conveyor by means of, e.g., a transponder. Alternatively, e.g., photo cells may be positioned near the feeding conveyor in order to cause the supplying conveyor to stop when an article passes the photo cell.

Alternatively or additionally, a supplying conveyor may be selected if at least one of the
30 articles being conveyed along the supplying conveyor has a priority level which is higher than the priority level of any other articles which may be transferred to the feeding conveyor from any supplying conveyor within a certain time interval. The time interval in question may, e.g., be the time necessary to convey the article having the high priority level from its current position to the position where it may be transferred to the feeding conveyor.
35 Thus, articles having a lower priority level may be transferred to the feeding conveyor

before the article having the high priority if they may be transferred to the feeding conveyor and further onto the main conveyor before the article having the high priority level arrives at the feeding conveyor. Thus, it is possible to ensure that an article having a high priority level may be transferred onto the feeding conveyor and further onto the main conveyor
5 without having to wait for other articles being conveyed along other supplying conveyors.

A supplying conveyor may also be selected even if the article having the high priority level is positioned on the supplying conveyor in such a way that articles having a lower priority level than articles being conveyed along other supplying conveyors are blocking the way.
10 Thus, it is possible to transfer the articles having a lower priority level to the feeding conveyor in order to let the article having the high priority level through.

Alternatively or additionally, a supplying conveyor may be selected if at least one of the articles being conveyed along the supplying conveyor has been there for a long time. It is
15 thus possible to put an upper limit to the period that an article should be allowed to wait for being transferred to the feeding conveyor. In case an article fulfils this criterion other criteria, such as the criterion concerning priority level, may be ignored.

The second set of criteria may consist of:
20

- (i) sufficient space for the article to be transferred from the feeding conveyor to the main conveyor is available on the main conveyor;
- (ii) an article must be present on the feeding conveyor in the vicinity of the main
25 conveyor;

Thus, an article may be transferred from the feeding conveyor to the main conveyor when sufficient space is available on the main conveyor and/or when an article is present in the vicinity of the main conveyor. As mentioned above, the article may be tracked by, e.g., a
30 transponder or the feeding conveyor may be operated using, e.g., a photo cell positioned near the main conveyor.

An article being supplied to one supplying conveyor may be defined as the last article to enter the feeding conveyor until a predetermined event occurs.

The predetermined event may be, e.g., the arrival of a specific article at a predetermined position along a certain supplying conveyor. The predetermined position is preferably in the vicinity of the feeding conveyor, but it may alternatively be in any other desired position along the supplying conveyor.

5

Thus, it may be possible to ensure that sufficient space is available on the feeding conveyor when an article having a very high priority level arrives at the point where articles are transferred from the relevant supplying conveyor onto the feeding conveyor. This may be obtained by stopping any other article from being transferred to the feeding conveyor in
10 a time interval before and up to the arrival of the article having the high priority level at the transferring point. The time interval should be sufficient long so that articles entering the feeding conveyor before the time interval can be transferred further onto the main conveyor before the end of the time interval. It may thus be ensured that the feeding conveyor is
empty when the article arrives.

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The predetermined event may alternatively be the arrival of an electronic signal, or another kind of signal, or any other suitable kind of event.

The other supplying conveyor(s) may be stopped from delivering articles to the feeding
20 conveyor substantially when the predetermined event occurs.

The method may further comprise the step of determining whether one or more articles are present on one or more of the supplying conveyors. This may be achieved by means of one or more photo cells and/or one or more cameras and/or bar codes attached to the
25 articles and/or transponders attached to the articles and/or by any other suitable means.

According to a second aspect, the present invention provides a method of feeding a flow of articles onto a main conveyor, the flow of articles being conveyed along an individual supplying conveyor, the method comprising the steps of:

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- transferring the flow of articles being conveyed along the supplying conveyor onto a feeding conveyor;
- transferring the flow of articles on the feeding conveyor onto the main conveyor,

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the conveying direction of the supplying conveyor being substantially parallel to the conveying direction of the main conveyor at the point where the flow of articles on the feeding conveyor is transferred onto the main conveyor. The step of transferring articles from the supplying conveyor to the feeding conveyor may comprise transferring the articles
5 from a first elevated level to a second level different from the first level.

The above description concerning, among other, types of conveyors, inductions, operation principles, control systems, also applies to the method according to the second aspect of the invention, except for parts of the description directed explicitly to the case, wherein at
10 least two supplying conveyors are arranged substantially perpendicular to the main conveyor.

The parallel arrangement of a supplying conveyor in relation to the main conveyor has the particular advantage that an article is not being re-oriented while transferred from the
15 supplying conveyor via the feeding conveyor to the main conveyor which, for certain applications, is an advantage with respect to operation and operation control.

The invention further relates to a conveyor system, a control system and a method for operating a conveyor system based on the principle of arranging a supplying conveyor
20 substantially parallel to the main conveyor.

The method according to the first and second aspects of the invention may be combined, so as to achieve a method combining the advantage of both aspects. Also, the conveyor systems, control systems and methods of operating according to the invention, cf. the
25 below description, may be combined.

A further aspect of the invention relates to a conveyor system for conveying articles, the conveyor system comprising:

- 30 - a main conveyor;
- at least one discharging station;
- means for discharging an article from the main conveyor at a discharging station;

- at least one supplying unit, each supplying unit comprising:
 - at least two supplying conveyors;
- 5 - a feeding conveyor, the feeding conveyor establishing a conveyor connection between each of the supplying conveyors and the main conveyor;
- means for transferring an article from any of its supplying conveyors onto its feeding conveyor;
- 10 - means for transferring an article from its feeding conveyor onto the main conveyor,

the conveying direction of at least one of the at least two supplying conveyors of each
15 supplying unit being substantially perpendicular to the conveying direction of the main conveyor in the position where the feeding conveyor of the supplying unit connects to the main conveyor.

The main conveyor is preferably a closed loop conveyor, most preferably a sorter. It may
20 be provided with carts or wagons, each cart or wagon carrying, e.g., a tiltable tray or a cross belt. It may, however, alternatively or additionally comprise other suitable conveyor means, such as belt conveyors and/or roller paths and/or chutes.

Preferably, the conveyor system has two or more discharging stations, such as when the
25 main conveyor is a sorter. This applies, e.g., for conveyor systems in airports or mail terminals or in other similar places. However, the conveyor system may comprise only one discharging station.

The discharging means may be located at or near each discharging station. It may
30 alternatively be located on each cart or wagon. It may comprise movable parts, such as one or more pistons which may be driven by, e.g., pneumatics or hydraulics or by any other suitable means. It may alternatively or additionally comprise conveyor means, such as a cross belt conveyor.

The supplying unit(s) is/are used for receiving articles and feeding them to the main conveyor. The articles may be received from, e.g., a production line and/or one or more loading stations. The articles may be fed to the supplying unit(s) manually or in an automatic way.

5

Each supplying unit comprises at least two supplying conveyors as described above and a feeding conveyor which establishes a conveyor connection between each of the supplying conveyors and the main conveyor, so that an article may be conveyed all the way from the location where it enters a supplying conveyor, onto the feeding conveyor, further onto the
10 main conveyor, and even further to the discharging station where the article leaves the conveyor system.

Each supplying unit further comprises transferring means for transferring an article from a supplying conveyor onto the feeding conveyor, and for transferring an article from the
15 feeding conveyor onto the main conveyor. The articles are preferably transferred by activating the respective conveyors. The transferring means may, however, comprise movable parts, such as one or more pistons being driven by, e.g., hydraulics or pneumatics by in any other suitable means.

20 As described above, the conveying direction of at least one of the supplying conveyors in each supplying unit is substantially perpendicular to the conveying direction of the main conveyor in order to use the space available on the main conveyor in an optimal way.

Preferably, the main conveyor is a sorter, most preferably a tilt tray sorter. It may, however,
25 alternatively be a cross belt sorter or any other suitable kind of sorter.

Another aspect of the invention provides a control system for controlling a flow of articles in a conveyor system as described above, the control system comprising:

- 30 - means for detecting the presence of an article at a predetermined position along a supplying conveyor;
- means for detecting the presence of an article at a predetermined position along a feeding conveyor;

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- means for causing the individual supplying conveyor to activate, so as to transfer an article from one of the supplying conveyors onto the corresponding feeding conveyor;
 - means for causing the individual supplying conveyor to deactivate, so as to prevent an article from being transferred from one of the supplying conveyors onto the corresponding feeding conveyor;
 - means for causing the individual feeding conveyor to activate, so as to transfer an article from one of the feeding conveyors onto the main conveyor;
 - means for causing the individual feeding conveyor to deactivate, so as to prevent an article from being transferred from one of the feeding conveyors onto the main conveyor;
 - means for determining whether sufficient space is available on the individual feeding conveyor for a certain article to be transferred from one of the supplying conveyors onto said feeding conveyor, so as to avoid collisions between articles being conveyed along said feeding conveyor and the article to be transferred;
 - means for determining whether sufficient space is available on the main conveyor for a certain article to be transferred from one of the feeding conveyors onto the main conveyor, so as to avoid collisions between articles being conveyed along the main conveyor and the article to be transferred.
- 25 The detecting means may be, e.g., photo cells and/or cameras and/or bar code scanners and/or any other suitable detecting means. It may alternatively or additionally be a manual input, so that a person who loads the articles onto one of the conveyors enters, e.g., a number corresponding to the article into, e.g., a computer.
- 30 The predetermined position along a supplying conveyor is preferably in the vicinity of the feeding conveyor, so that the control system "knows" that an article is soon to be transferred from the relevant supplying conveyor onto the corresponding feeding conveyor. It may, however, alternatively be any other position desired. If the control system "knows" the velocity of the supplying conveyor, it will be able to calculate the time of arrival of the
- 35 article at the transferring point from the detection of the presence of the article at a

predetermined position which is not in the vicinity of the feeding conveyor. Thus, a smooth transfer of the articles from the individual supplying conveyor onto the corresponding feeding conveyor may be achieved.

- 5 Analogously, the predetermined position along a feeding conveyor is preferably in the vicinity of the main conveyor, but may alternatively be further away.

The means for causing activation/deactivation of the individual conveyors may, e.g., be signals which are sent by the control system. The signals may be sent to, e.g., a computer
10 controlling the relevant conveyor(s). It may alternatively be electrical signals which are sent directly to the relevant conveyor(s) or to a switch, so that the conveyor(s) is/are activated when the switch is on and deactivated when the switch is off.

The determining means may be, e.g., one or more cameras and/or one or more photo cells
15 and/or any other suitable means. It may alternatively be a "tracking function" of the control system, so that the control system keeps track of the individual articles being conveyed by the conveyor system, thus keeping track of the available and the occupied space of the individual conveyors.

20 In a very simple embodiment of a control system according to the invention an article enters one of the supplying conveyors, the supplying conveyor being activated before or at the entering of the article. The article is then conveyed along the supplying conveyor until it reaches a predetermined position in the vicinity of the corresponding feeding conveyor. At the predetermined position a photo cell is preferably located, so that the control system
25 may detect the presence of the article at the predetermine position. Preferably, the arrival of the article at the photo cell causes the supplying conveyor to deactivate, so that the article is brought to a stop, so as to prevent it from being transferred onto the corresponding feeding conveyor.

30 When sufficient space is available on the feeding conveyor the supplying conveyor is activated so that the article is transferred onto the feeding conveyor, the feeding conveyor being activated before or at this time.

The article is then conveyed along the feeding conveyor until it reaches a predetermined position, preferably in the vicinity of the main conveyor, where it is brought to a stop, preferably in a way similar to the one described above.

- 5 When sufficient space is available on the main conveyor, the feeding conveyor is activated so that the article is transferred onto the main conveyor.

The control system may further comprise:

- 10 - means for detecting when an article enters the conveyor system;
- means for receiving information about the article or articles, the information belonging to at least one of the following categories:
 - (a) size
 - 15 (b) priority level
 - (c) destination
 - (d) weight
 - (e) dimensions
 - (f) time of arrival
- 20 - means for determining the distribution of available space in the conveyor system;
- processor means for processing the information, creating a sequence of articles in the conveyor system based on the information, and sending activation signals to the
- 25 transferring means and/or to the discharging means so as to activate them;
- storing means for storing the information and the sequence of articles.

The detecting means may be, e.g., one or more photo cells and/or one or more cameras
 30 and/or any other suitable means. It is preferably positioned at the entrance of each of the supplying conveyors. It may, however, alternatively or additionally be positioned in any other suitable position. Alternatively, the detecting means may be a person who sees that the article enters one of the supplying conveyors and then manually enters this information into, e.g., a computer.

The information receiving means may receive the information from, e.g., a bar code scanner and/or a volume scanner and/or a pair of scales and/or any other suitable means generating relevant information about the article. It may alternatively receive the information by a manual input.

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Information about the size of the article may be utilised for determining how much space is needed on the feeding conveyor and/or the main conveyor in order to accommodate the article.

- 10 Information about the priority level of the article may be utilised for determining how important the article is. It may thus be possible to decide whether the article is important enough that it should be transferred onto the feeding conveyor and/or onto the main conveyor before another article having a different priority level, or whether the other article should be transferred first.

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Information about the destination of the article may be utilised for discharging the article at the correct discharging station.

- Information about the weight of the article may be utilised at, e.g., airport check-in stations or at mail terminals. At airports the luggage is usually weighted at the check-in in order to control that the passenger is not carrying more than the allowed amount of luggage. At mail terminals parcels and letters are usually weighted in order to control that the correct postage has been paid.

- 25 Information about the dimensions of the article may be utilised to determine how much space is needed on the feeding conveyor and/or on the main conveyor. If the article is very large in one direction, but not in the other directions, it may be necessary to accommodate much space on the feeding conveyor and/or the main conveyor. It may, however, also be possible to orient the article in such a way that the article accommodates a minimum of
30 space on the feeding conveyor and/or on the main conveyor.

Information about the time of arrival of the article may be utilised to calculate the period an article have been on a certain conveyor. Thus, it may be avoided that an article waits on a conveyor for a longer period than a predetermined time interval.

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The determining means may be capable of determining the distribution of available space in the total conveyor system, including the space available on the individual feeding conveyor and/or on the main conveyor. It may thus be possible to determine whether a certain article may be conveyed from the supplying conveyor onto the corresponding
5 feeding conveyor, further onto the main conveyor, and even further to the relevant discharging station without having to stop. Furthermore, such determining may be performed regardless of at which position in the conveyor system the article is located.

The processor means may be, e.g., a general purpose computer. The transferring means
10 and/or the discharging means are preferably operated in accordance with the sequence of articles, so that the articles are conveyed by the conveyor system in such a way that, e.g., important articles are conveyed before less important articles and/or in such a way that no article waits for its turn for a longer period than a predetermined time interval.

15 The storing means may comprise a computer.

The supplying conveyor of the control system may be activated when sufficient space is available on the feeding conveyor and according to the sequence of articles, and the
feeding conveyor of the control system may be activated when sufficient space is available
20 on the main conveyor and according to the sequence of articles.

The sequence may include articles from at least two different supplying units. In this case the control system may be capable of controlling the flow of articles from the at least two supplying units. The articles from the at least two supplying units may thus be transferred
25 to the main conveyor according to the sequence of articles, so that, e.g., important articles are transferred before less important articles and/or so that no articles remain on one of the supplying units for a longer period than a predetermined time interval.

The sequence may be updated whenever an article enters the conveyor system, so that,
30 e.g., the most important article in the conveyor system always will be high in the sequence of articles.

The storing means may further store one or more sets of criteria.

Another aspect of the invention provides a method of operating a conveyor system, the conveyor system comprising:

- a main conveyor;
- 5 - at least one supplying unit, each supplying unit comprising:
 - at least two supplying conveyors;
 - 10 - a feeding conveyor, the feeding conveyor establishing a conveyor connection between each of the supplying conveyors and the main conveyor;

the conveying direction of at least one of the supplying conveyors being substantially perpendicular to the conveying direction of the main conveyor at the point where the
15 feeding conveyor connects to the main conveyor,

the conveyor system providing a control system for controlling the flow of articles in the conveyor system;

- 20 the method comprising the step of feeding at least two flows of articles from one of the supplying units onto the main conveyor, each flow of articles being conveyed along individual supplying conveyors.

The conveyor system is thus a conveyor system as described above, and the method
25 comprises the step of feeding at least two flows of articles from one of the supplying units onto the main conveyor according to the method described above.

The method may further comprise the step of assigning a priority level to substantially every article being conveyed by the conveyor system, by means of the control system.

30 The method may further comprise the steps of selecting one of the at least one supplying units according to at least one criterion selected from a third set of criteria, and transferring an article from the selected one of the at least one supplying units onto the main conveyor.

35 The third set of criteria may consist of:

(j) sufficient space for an article to be transferred from the supplying unit onto the main conveyor is available on the main conveyor;

5 (k) an article on the feeding conveyor of the supplying unit is present in the vicinity of the main conveyor;

(l) at least one of the articles being conveyed along one of the conveyors of the supplying unit has the highest priority level of all articles which may be transferred from any
10 supplying unit onto the main conveyor within a certain time interval;

(m) at least one of the articles being conveyed along one of the conveyors of the supplying unit has been on at least one of the conveyors of the supplying unit for a longer
time interval than a predetermined time interval.

15

Thus, a supplying unit may be selected if sufficient space is available so that, e.g., the article on the supplying unit being nearest to the main conveyor may be transferred from the supplying unit onto the main conveyor.

20 Alternatively and/or additionally, a supplying unit may be selected if an article on the feeding conveyor of the supplying unit is present in the vicinity of the main conveyor.

Alternatively and/or additionally, a supplying unit may be selected if at least one of the articles being conveyed along one of the conveyors of the supplying unit has the highest
25 priority level of all articles which may be transferred from any supplying unit onto the main conveyor within a certain period. This applies if said article is the one on the supplying unit being nearest to the main conveyor. However, it also applies if said article is positioned further away, so that other articles having a lower priority level are blocking the way. In this case these articles may have to be transferred onto the main conveyor in order to make
30 room for the article having the high priority level.

Alternatively and/or additionally, a supplying unit may be selected if at least one of the articles being conveyed along one of the conveyors of the supplying unit has been on at least one of the conveyors of the supplying unit for a longer time interval than a

predetermined time interval. It may thus be possible to put an upper limit to the time interval an article should be allowed to wait to be conveyed.

The method may further comprise the step of creating a sequence of articles according to
5 the third set of criteria, and the articles may be transferred from the supplying units onto the main conveyor according to this sequence of articles.

The invention will now be further described with reference to the drawings in which:

10 Fig. 1 is a top view of a supplying unit,

Fig. 2 is a schematic view of a conveyor system according to the invention,

Fig. 3 is a top view of a supplying unit,

15

Fig. 4 is a top view of a supplying unit having different supplying conveyors arranged substantially perpendicular to a main conveyor and substantially parallel to the main conveyor, respectively.

20 Fig. 1 illustrates an elevated view of a supplying unit 10 to be used in a conveyor system according to the invention. The supplying unit 10 comprises two supplying conveyors 11, a feeding conveyor 12, and a main conveyor 13. Only the part of the main conveyor 13 being near the supplying unit 10 is shown. The main conveyor 13 comprises carts 14, each of which may carry a tray, e.g., a tiltable tray, or a cross belt.

25

Both of the supplying conveyors 11 are positioned in such a way that their conveying direction is perpendicular to the conveying direction of the main conveyor 13, as is illustrated at points 15a and 15b.

30 The conveying direction of the feeding conveyor 12 defines an angle with the main conveyor 13, and an angle with each of the supplying conveyors 11. These angles are between 0° and 90°. Thus, when an article is transferred from a supplying conveyor 11 onto the feeding conveyor 12 or from the feeding conveyor 12 onto the main conveyor 13, the velocity of the article will have a component in the conveying direction of the conveyor
35 12, 13 onto which it is transferred. This ensures a smooth transfer of the article.

The supplying unit 10 is preferably operated in the following way. An article to be conveyed by the conveyor system is introduced into the system at a supplying conveyor 11, preferably at one end 16 of a supplying conveyor 11. It is then conveyed along the
5 supplying conveyor 11 until it reaches the feeding conveyor 12 at the transferring point 17 between the supplying conveyor 11 and the feeding conveyor 12. The control system then checks whether one or more of the criteria of the first set of criteria is fulfilled. This may, however, have been carried out before the article reaches the transferring point 17, so as to allow the article to continue onto the feeding conveyor 12 without having to stop at the
10 transferring point 17. The article may alternatively be stopped at or near the transferring point 17, e.g., by means of a photo cell.

When a sufficient number of the criteria are fulfilled, the article is transferred onto the feeding conveyor 12. This is preferably performed by activating the supplying conveyor 11,
15 so as to convey the article onto the feeding conveyor 12.

The article is then conveyed by the feeding conveyor 12 until it reaches the main conveyor 13 at the transferring point 18 between the feeding conveyor 12 and the main conveyor 13. The control system then checks whether one or more of the criteria of the second set of
20 criteria is fulfilled. This may, however, have been carried out before the article reaches the transferring point 18, so as to allow the article to continue onto the main conveyor 13 without having to stop at the transferring point 18. The article may alternatively be stopped at or near the transferring point 18, e.g., by means of a photo cell.

25 When a sufficient number of the criteria are fulfilled, the article is transferred onto the main conveyor 13. This is preferably performed by activating the feeding conveyor 12, so as to convey the article onto the main conveyor 13.

The article has now been introduced onto the main conveyor 13, and it will now be
30 conveyed to the relevant discharging station where it will be discharged.

Fig. 2 is a schematic view of a conveyor system according to the invention. The conveyor system comprises a main conveyor 13, two supplying units 10 and three discharging stations 19. One supplying unit 10 comprises three supplying conveyors 11 and one

feeding conveyor 12, and the other supplying unit 10 comprises two supplying conveyors 11 and one feeding conveyor 12.

Each of the supplying units 10 is operated as described above.

5

When the conveyor system is operating flows of articles from both of the supplying units 10 are transferred onto the main conveyor 13.

The conveyor system is preferably operated in the following way. An article to be conveyed
10 by the conveyor system is introduced into the system in the way described above. When the article reaches the transferring point 18 between the feeding conveyor 12 and the main conveyor 13 the control system checks whether one or more of the criteria of the third set of criteria is fulfilled. This may, however, have been carried out before the article reaches the transferring point 18, so as to allow the article to continue onto the main conveyor 13
15 without having to stop at the transferring point 18. The article may alternatively be stopped at or near the transferring point 18, e.g., by means of a photo cell.

When a sufficient number of the criteria are fulfilled, the article is transferred onto the main conveyor 13. This is preferably performed by activating the feeding conveyor 12, so as to
20 convey the article onto the main conveyor 13.

The article is then conveyed by the main conveyor 13 until it reaches the relevant discharging station 19 where it is discharged. The discharging means may be located at or near the discharging stations 19, or it may be located at the individual cart carrying the
25 articles. The discharging means is preferably a tiltable tray or a cross belt positioned on the individual cart.

Fig. 3 is a top view of a supplying unit 10 to be used in a conveyor system according to the invention wherein the supplying conveyor is arranged substantially parallel to the main
30 conveyor. The supplying unit 10 comprises one supplying conveyor 11, a feeding conveyor 12, and a main conveyor 13. The main conveyor 13 comprises carts 14, each of which may carry a tray, e.g., a tiltable tray, or a cross belt. The direction of the supplying conveyor 11 is substantially parallel to the conveying direction of the main conveyor 13 at the point 18 where the flow of articles in the feeding conveyor is transferred into the main conveyor.

35

The supplying conveyor 11 may be positioned at higher level than the feeding conveyor 12. Thus, articles can be dropped from the supplying conveyor to the feeding conveyor.

Fig. 4 is a top view of a supplying unit 10 having different supplying conveyors 11, 11a, 11b arranged substantially perpendicular to a main conveyor and substantially parallel to the main conveyor, respectively. First supplying conveyors 11 are arranged opposite to second supplying conveyor 11a, each of which is arranged substantially perpendicular to the main conveyor 13. The second supplying conveyor 11a is arranged so that the velocity component in the feeding-conveyor direction of articles is reversed when the articles are transferred from that supplying conveyor 11a to the feeding conveyor 12. In another embodiment (not shown), the aforementioned velocity component is not reversed. Embodiments having supplying conveyors 11, 11a arranged on opposite sides of the feeding conveyor are beneficial with respect to achievement of high capacity of the feeding installation 10.

The embodiment of Fig. 4 further has a third supplying conveyor 11b arranged substantially parallel to the main conveyor.

CLAIMS

1. A method of feeding at least two flows of articles onto a main conveyor, each of the at least two flows of articles being conveyed along an individual supplying conveyor, the
5 method comprising the steps of:

- transferring each of the flows of articles being conveyed along the supplying conveyors onto a feeding conveyor, thereby merging the at least two flows of articles into one flow of articles on the feeding conveyor;

10

- transferring the flow of articles on the feeding conveyor onto the main conveyor,

the conveying direction of at least one of the at least two supplying conveyors being substantially perpendicular to the conveying direction of the main conveyor at the point

15 where the flow of articles on the feeding conveyor is transferred onto the main conveyor.

2. A method according to claim 1, wherein the conveying direction of the at least one of the at least two supplying conveyors is substantially parallel to the conveying direction of the main conveyor at the point where the flow of articles in the feeding conveyor is transferred
20 into the main conveyor.

3. A method according to claim 1 or 2, further comprising the steps of:

- selecting one of the at least two supplying conveyors according to at least one
25 criterion selected from a first set of criteria;
- transferring an article from the selected one of the at least two supplying conveyors onto the feeding conveyor.

30 4. A method according to any of claims 1-3, further comprising the step of transferring an article from the feeding conveyor onto the main conveyor at a given time and according to at least one criterion selected from a second set of criteria.

5. A method according to any of claims 1-4, further comprising the step of assigning a priority level to substantially every article being conveyed along any of the supplying conveyors.

5 6. A method according to claim 5, wherein the first set of criteria consists of:

(a) sufficient space for an article to be transferred from the supplying conveyor to the feeding conveyor is available on the feeding conveyor;

10 (b) an article on the supplying conveyor is present in the vicinity of the feeding conveyor;

(c) at least one of the articles being conveyed along the supplying conveyor has the highest priority level of all articles which may be transferred from any supplying conveyor to the feeding conveyor within a certain time interval;

15 (d) at least one of the articles being conveyed along the supplying conveyor has been on the supplying conveyor for a longer time interval than a predetermined time interval.

7. A method according to any of claims 4-6, wherein the second set of criteria consists of:

20

(i) sufficient space for the article to be transferred from the feeding conveyor to the main conveyor is available on the main conveyor;

25 (ii) an article must be present on the feeding conveyor in the vicinity of the main conveyor.

8. A method according to claim 6 or 7, wherein criterion (c) is ignored in case an article fulfils criterion (d).

30 9. A method according to any of the preceding claims, wherein an article being supplied to one supplying conveyor is defined as the last article to enter the feeding conveyor until a predetermined event occurs.

10. A method according to claim 9, wherein the other supplying conveyor(s) are stopped from delivering articles to the feeding conveyor substantially when the predetermined event occurs.
- 5 11. A method according to any of the preceding claims, further comprising the step of determining whether one or more articles are present on one or more of the supplying conveyors.
12. A method of feeding a flow of articles onto a main conveyor, the flow of articles being
10 conveyed along an individual supplying conveyor, the method comprising the steps of:
- transferring the flow of articles being conveyed along the supplying conveyor onto a feeding conveyor;
 - 15 - transferring the flow of articles on the feeding conveyor onto the main conveyor;
- the conveying direction of the supplying conveyor being substantially parallel to the conveying direction of the main conveyor at the point where the flow of articles on the feeding conveyor is transferred onto the main conveyor.
- 20 13. A method according to any of the preceding claims, wherein the step of transferring articles from the supplying conveyor to the feeding conveyor comprises transferring the articles from a first elevated level to a second level different from the first level.
- 25 14. A conveyor system for conveying articles, the conveyor system comprising:
- a main conveyor;
 - at least one discharging station;
 - 30 - means for discharging an article from the main conveyor at a discharging station;
 - at least one supplying unit, each supplying unit comprising:
- 35 - at least two supplying conveyors;

- a feeding conveyor, the feeding conveyor establishing a conveyor connection between each of the supplying conveyors and the main conveyor;
- 5
- means for transferring an article from any of its supplying conveyors onto its feeding conveyor;
 - means for transferring an article from its feeding conveyor onto the main conveyor,
- 10
- the conveying direction of at least one of the at least two supplying conveyors of each supplying unit being substantially perpendicular to the conveying direction of the main conveyor in the position where the feeding conveyor of the supplying unit connects to the main conveyor.
- 15
15. A conveyor system for conveying articles, the conveyor system comprising:
- a main conveyor;
- 20
- at least one discharging station;
 - means for discharging an article from the main conveyor at a discharging station;
 - at least one supplying unit, each supplying unit comprising:
- 25
- at least one supplying conveyor;
 - a feeding conveyor, the feeding conveyor establishing a conveyor connection between the supplying conveyor and the main conveyor;
- 30
- means for transferring an article from any of its supplying conveyors onto its feeding conveyor;
 - means for transferring an article from its feeding conveyor onto the main conveyor,
- 35

the conveying direction of at least one of the at least one supplying conveyor of each supplying unit being substantially parallel to the conveying direction of the main conveyor in the position where the feeding conveyor of the supplying unit connects to the main
5 conveyor.

16. A conveyor system according to claim 14 or 15, wherein the supplying conveyor(s) are at a level different from the level of the feeding conveyor.

10 17. A conveyor system according to any of claims 14-16, wherein the main conveyor is a sorter.

18. A conveyor system according to any of claims 14-16, wherein the main conveyor is a tilt tray conveyor.

15

19. A conveyor system according to any of claims 14-16, wherein the main conveyor is a cross belt conveyor.

20. A control system for controlling a flow of articles in a conveyor system according to any
20 of claims 14-19, the control system comprising:

- means for detecting the presence of an article at a predetermined position along a supplying conveyor;
- 25 - means for detecting the presence of an article at a predetermined position along a feeding conveyor;
- means for causing the individual supplying conveyor to activate, so as to transfer an article from one of the supplying conveyors onto the corresponding feeding conveyor;
- 30 - means for causing the individual supplying conveyor to deactivate, so as to prevent an article from being transferred from one of the supplying conveyors onto the corresponding feeding conveyor;

- means for causing the individual feeding conveyor to activate, so as to transfer an article from one of the feeding conveyors onto the main conveyor;
- 5 - means for causing the individual feeding conveyor to deactivate, so as to prevent an article from being transferred from one of the feeding conveyors onto the main conveyor;
- 10 - means for determining whether sufficient space is available on the individual feeding conveyor for a certain article to be transferred from one of the supplying conveyors onto said feeding conveyor, so as to avoid collisions between articles being conveyed along said feeding conveyor and the article to be transferred;
- 15 - means for determining whether sufficient space is available on the main conveyor for a certain article to be transferred from one of the feeding conveyors onto the main conveyor, so as to avoid collisions between articles being conveyed along the main conveyor and the article to be transferred.

21. A control system according to claim 20, further comprising:

- 20 - means for detecting when an article enters the conveyor system;
- means for receiving information about the article or articles, the information belonging to at least one of the following categories:
 - (a) size
 - 25 (b) priority level
 - (c) destination
 - (d) weight
 - (e) dimensions
 - (f) time of arrival
- 30 - means for determining the distribution of available space in the conveyor system;
- processor means for processing the information, creating a sequence of articles in the conveyor system based on the information, and sending activation signals to the transferring means and/or to the discharging means so as to activate them;
- 35

- storing means for storing the information and the sequence of articles.

22. A control system according to claim 21, wherein the supplying conveyor is activated
5 when sufficient space is available on the feeding conveyor and according to the sequence of articles.

23. A control system according to claim 21 or 22, wherein the feeding conveyor is activated
when sufficient space is available on the main conveyor and according to the sequence of
10 articles.

24. A control system according to any of claims 21-23, wherein the sequence includes articles from at least two different supplying units.

15 25. A control system according to any of claims 21-24, wherein the sequence is updated whenever an article enters the conveyor system.

26. A control system according to any of claims 21-25, wherein the storing means is further storing one or more sets of criteria.

20

27. A method of operating a conveyor system, the conveyor system comprising:

- a main conveyor;

25 - at least one supplying unit, each supplying unit comprising:

- at least two supplying conveyors;

- a feeding conveyor, the feeding conveyor establishing a conveyor connection
30 between each of the supplying conveyors and the main conveyor;

the conveying direction of at least one of the supplying conveyors being substantially perpendicular to the conveying direction of the main conveyor at the point where the feeding conveyor connects to the main conveyor,

35

the conveyor system providing a control system for controlling the flow of articles in the conveyor system;

the method comprising the step of feeding at least two flows of articles from one of the
5 supplying units onto the main conveyor, each flow of articles being conveyed along individual supplying conveyors.

28. A method according to claim 27, further comprising the step of assigning a priority level
to substantially every article being conveyed by the conveyor system, by means of the
10 control system.

29. A method according to claim 27 or 28, further comprising the steps of:

- selecting one of the at least one supplying units according to at least one criterion
15 selected from a third set of criteria;
- transferring an article from the selected one of the at least one supplying units onto the main conveyor.

20 30. A method according to claim 29, wherein the third set of criteria consists of:

- (j) sufficient space for an article to be transferred from the supplying unit onto the main conveyor is available on the main conveyor;
- 25 (k) an article on the feeding conveyor of the supplying unit is present in the vicinity of the main conveyor;
- (l) at least one of the articles being conveyed along one of the conveyors of the supplying unit has the highest priority level of all articles which may be
30 transferred from any supplying unit onto the main conveyor within a certain time interval;
- (m) at least one of the articles being conveyed along one of the conveyors of the supplying unit has been on at least one of the conveyors of the supplying unit
35 for a longer time interval than a predetermined time interval.

31. A method according to claim 30, further comprising the step of creating a sequence of articles according to the third set of criteria.

5 32. A method according to claim 31, wherein the articles are transferred from the supplying units onto the main conveyor according to the sequence of articles.

33. A method of operating a conveyor system, the conveyor system comprising:

10 - a main conveyor;

- at least one supplying unit, each supplying unit comprising:

- at least one supplying conveyor;

15

- a feeding conveyor, the feeding conveyor establishing a conveyor connection between the supplying conveyor and the main conveyor;

20 the conveying direction of at least one supplying conveyor being substantially parallel to the conveying direction of the main conveyor at the point where the feeding conveyor connects to the main conveyor,

the conveyor system providing a control system for controlling the flow of articles in the conveyor system;

25

the method comprising the step of feeding at least one flow of articles from the supplying unit onto the main conveyor, each flow of articles being conveyed along the supplying conveyor.

30

1/4

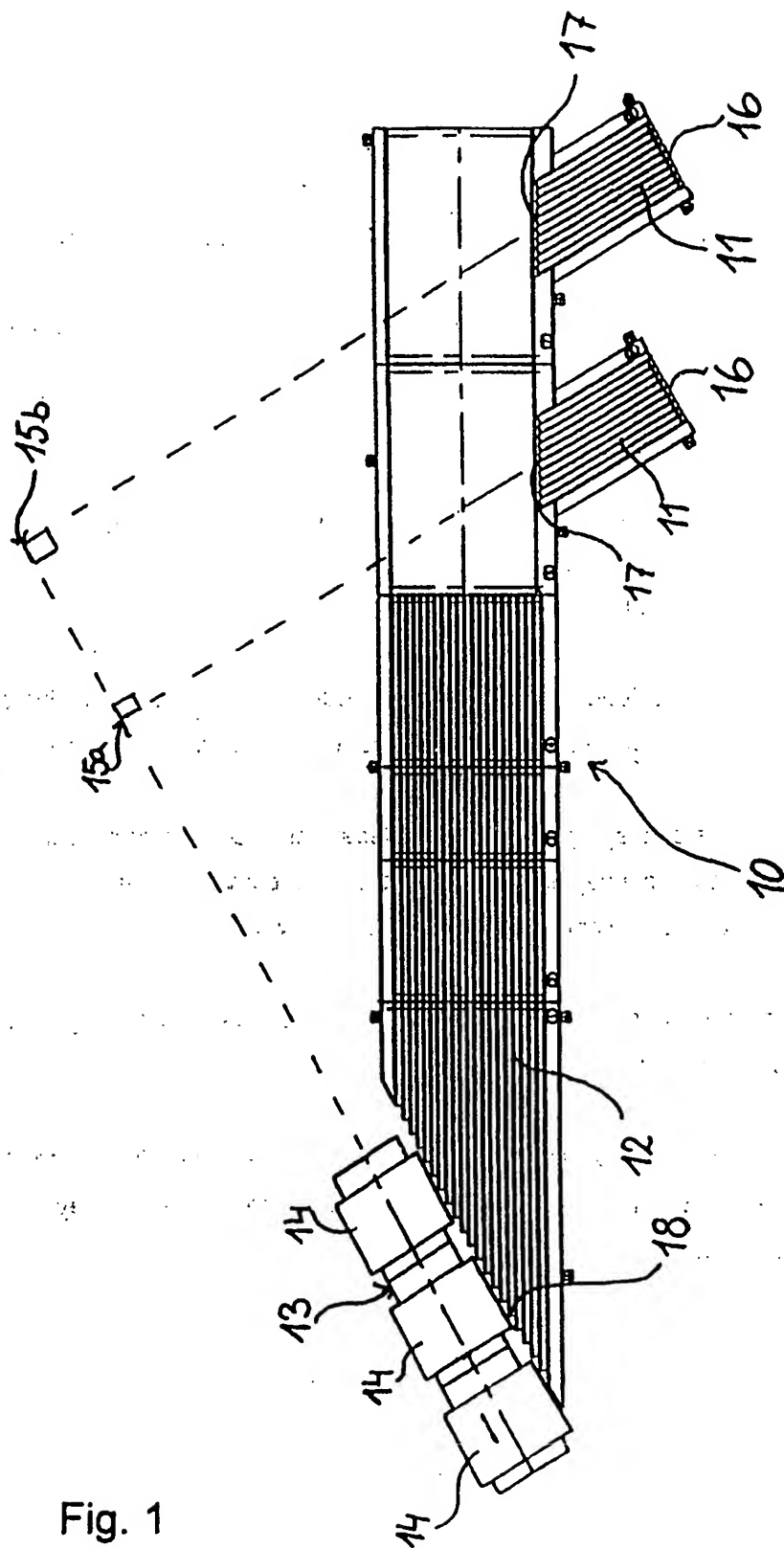


Fig. 1

2/4

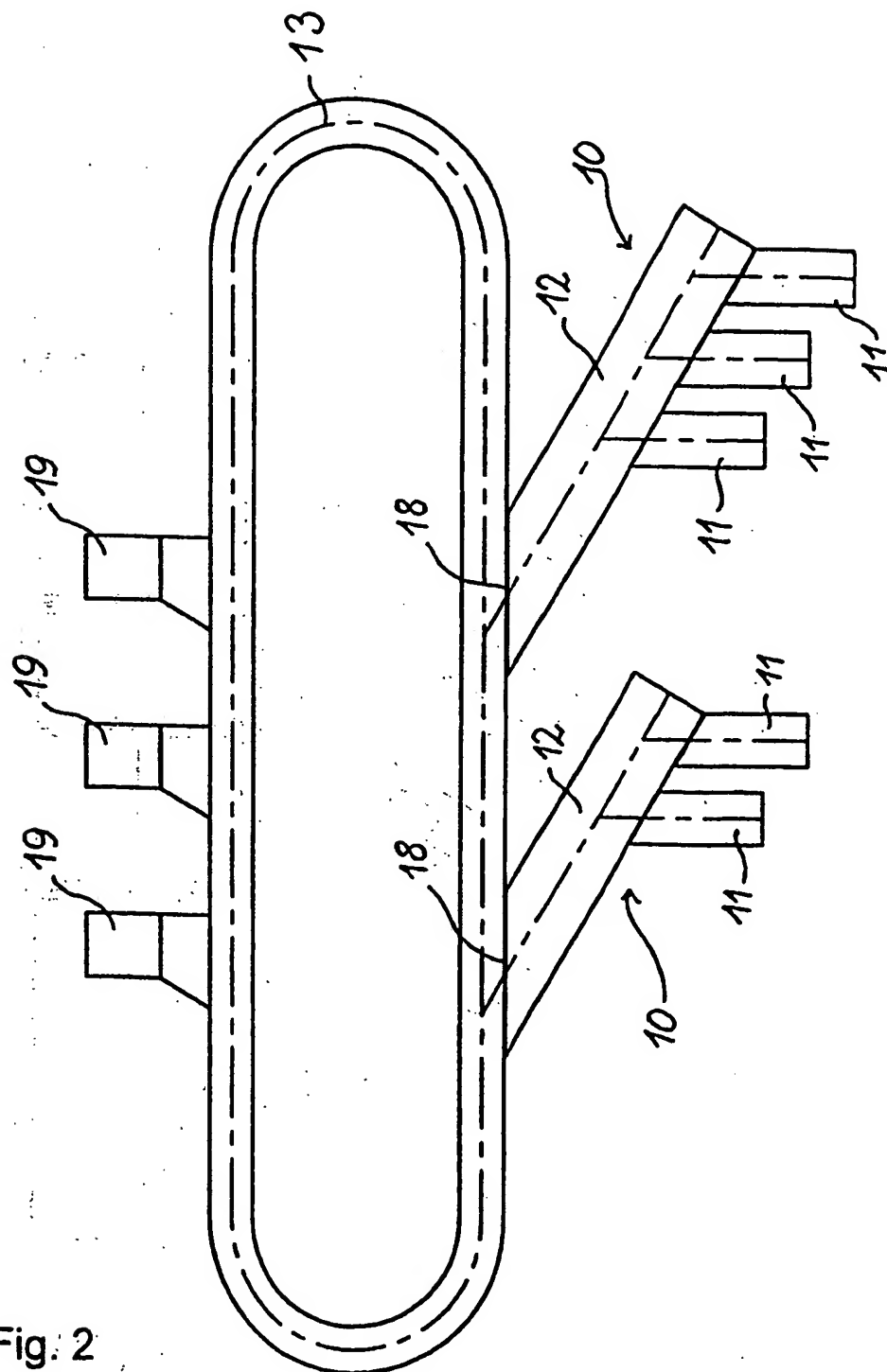


Fig. 2

3/4

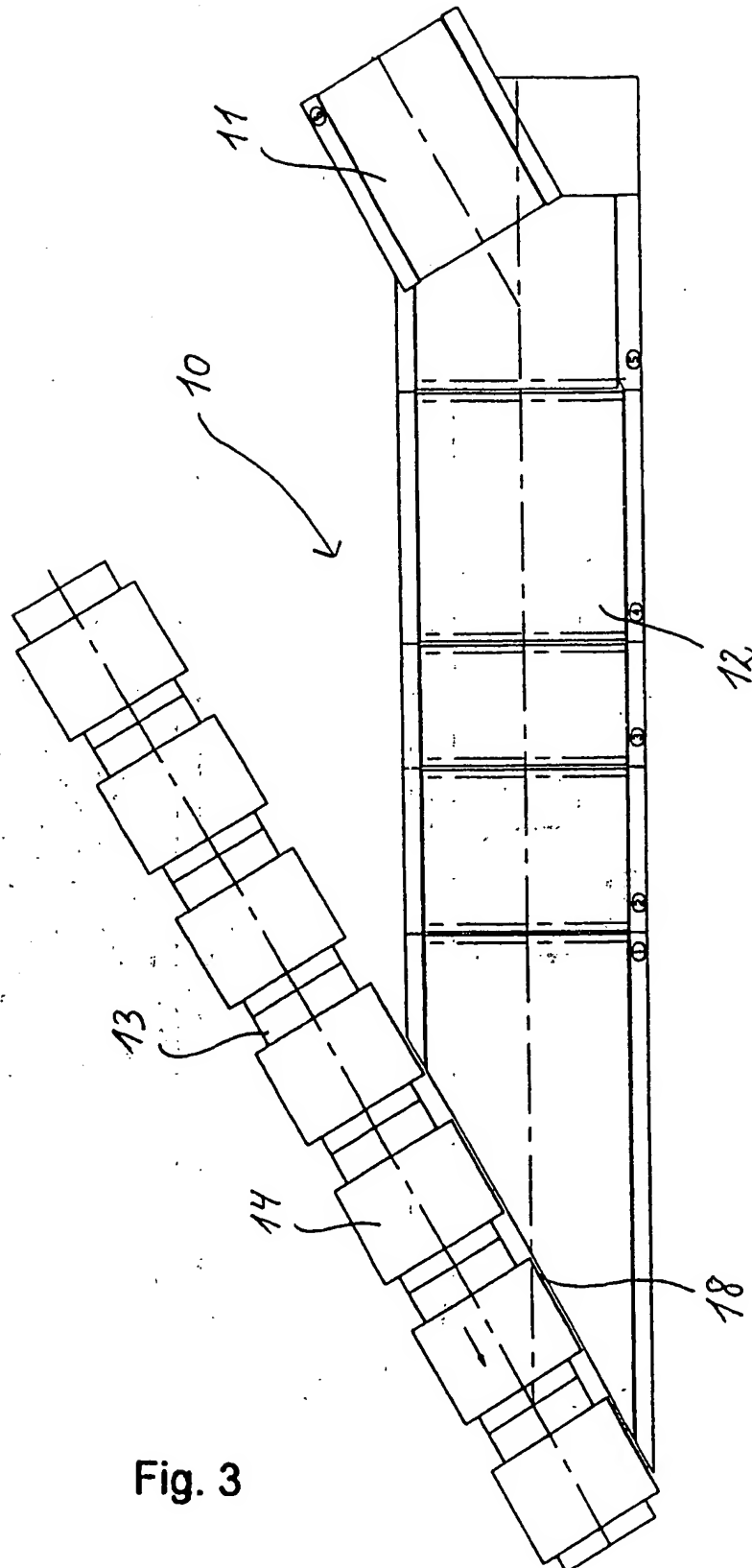


Fig. 3

4/4

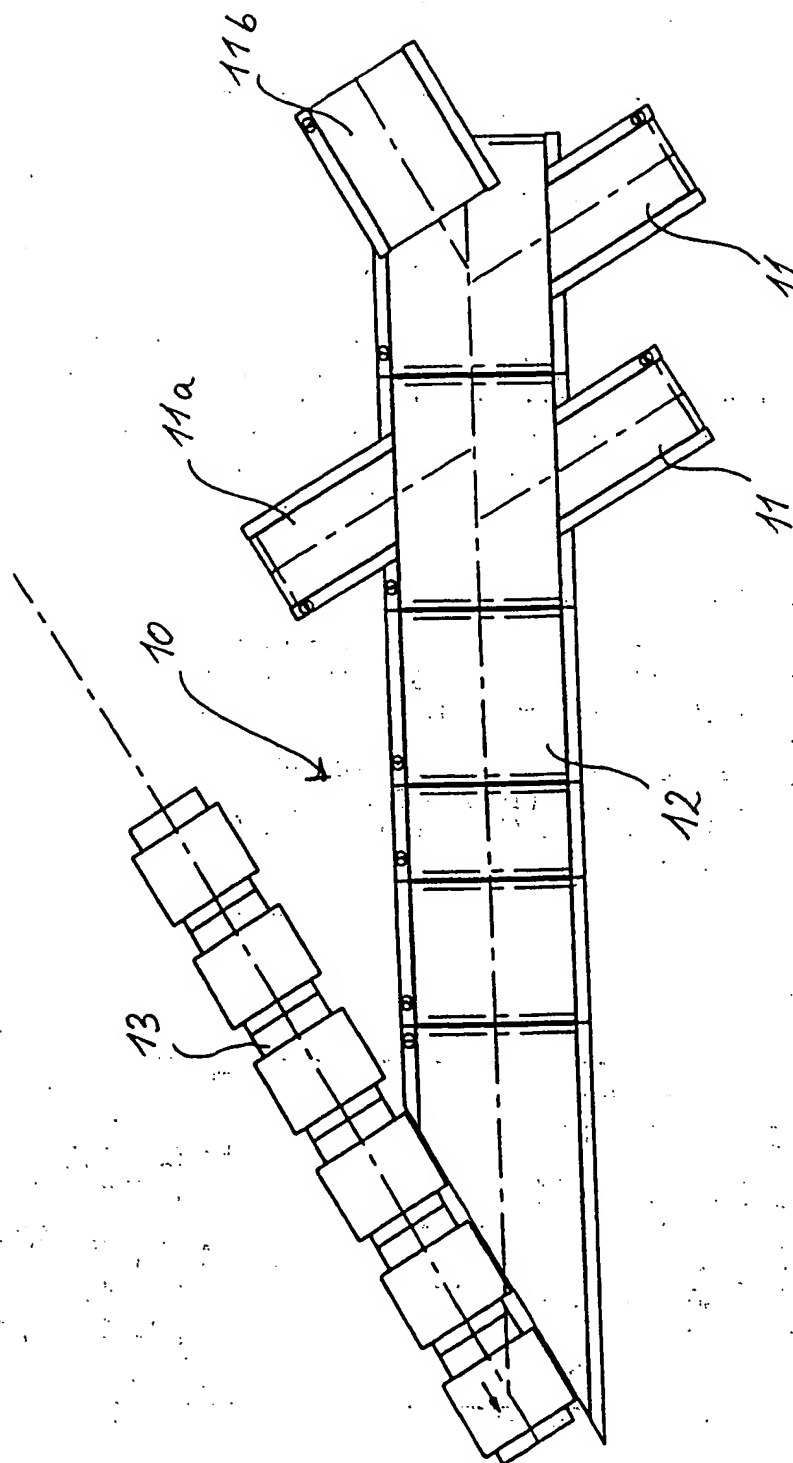


Fig. 4

INTERNATIONAL SEARCH REPORT

Intern Application No

PCT/UK 99/00358

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B65G43/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B65G B07C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 491 903 A (HEDRICK ROBERT R ET AL) 27 January 1970 (1970-01-27) the whole document	1,3,4, 14,17, 18,20, 27,28
A	DE 44 13 967 A (TGW-TRANSPORTGERÄTE G.M.B.H) 3 November 1994 (1994-11-03) abstract; claims; figure 1	1,2,12, 15,33
A	US 3 880 298 A (JAMES D. HABEGGER) 29 April 1975 (1975-04-29) column 3, line 45 -column 4, line 42; figure 1	1,4,14, 17,18

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/DK 99/00358

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